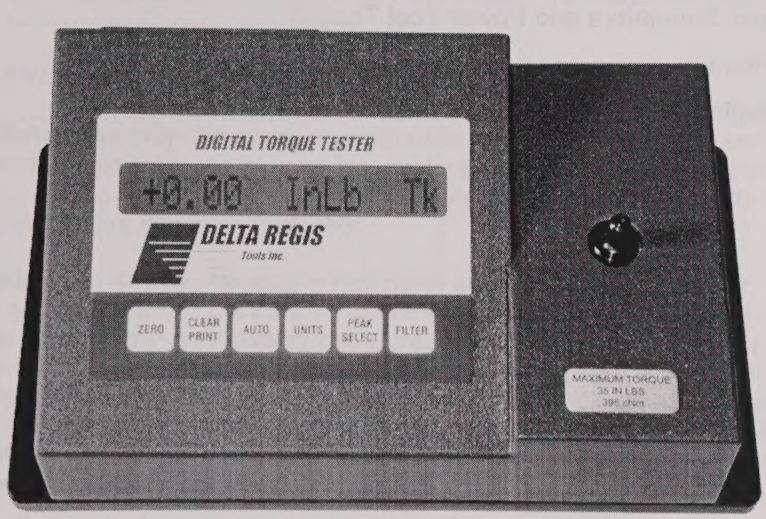
Delta Regis DRTT Series Torque Tester



User's Manual

For Models DRTT10, DRTT35, DRTT100, DRTT300

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Safety Recommendations

For your safety and the safety of others, read and understand the safety recommendations before installing or operating the Delta Regis Torque Tester.

Delta Regis DRTT torque testers are designed and constructed to provide the user with a safe and reliable means of calibrating torque wrenches and power tools. Should a fault occur which impairs its function and/or compromises its safe use, immediately disconnect the unit from its power source and secure against unintended operation. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

When testing tool torque, always wear protective equipment.

Impact resistant eye protection must be worn while operating or working near any power tool. For additional information on eye and face protection, refer to Federal OSHA Regulations, 29CFR S 1910.133, Eye and Face Protection, and American National Standards Institute, ANSI Z87.1, Occupational Eye and Face Protection.

Hearing protection is recommended in high noise areas of 85 dBA or greater. The operation of other tools and equipment in the area, reflective surfaces, process noises and resonant structures can substantially contribute to, and increase the noise level in the area. Excessive air pressure above 90 psig or worn motor components can also increase sound level emitted by the tool. Proper hearing conservation measures, including annual audiograms and training in the use and fit of hearing protection devices may be necessary. For additional information on hearing protection, refer to CFR 1910.95, Occupational Noise Exposure, and American National Standards Institute, ANSI S12.6, Hearing Protectors.

Ensure that the Delta Regis Torque Tester is securely mounted.

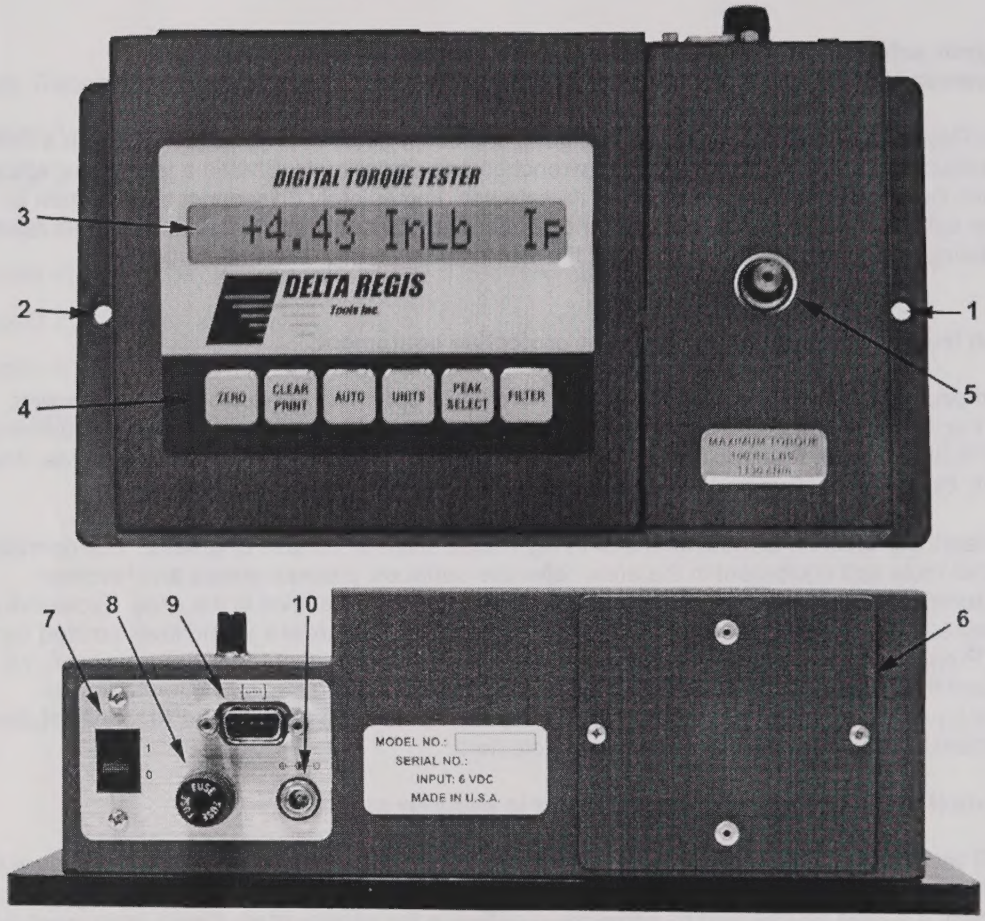
DRTT testers should be mounted and located such that inadvertent movement will not allow the unit to be dislodged, possibly causing personal injury or damage to the unit. Should the unit be dropped, it should be checked by someone qualified in the service of electronic instrumentation.

Warning: Shock Hazard. Disconnect power to the unit before attempting to service. Any internal adjustments should be carried out only by skilled persons who are aware of the hazards of dealing with live circuitry. The cabinet which houses the circuitry provides protection against dust and falling dirt. This unit should be used only indoors. Do not use in explosive atmospheres.

Warning: Shock Hazard. Damaged cords or plugs are dangerous, and should be repaired or replaced as necessary.

Caution: Tripping Hazard. Electrical cords and tool cables must be organized and located in such a manner as to reduce the likelihood of the user or others of tripping or becoming entangled in electrical cords and cables used with this product. Route electrical cord so that it is not subject to chafing, crushing, or severing.

Chapter 1 - Features



1) Back Plate
2) Mounting Hole (2 locations)
3) LCD Display
4) Keys - Zero, Clear/Print , Auto, Units, Peak Select, Filter
5) Transducer
6) Battery Compartment Cover
7) Power Switch
8) Fuse
9) Serial Port
10) Charger Receptacle

Back Plate

The Back Plate of your Delta Regis DRTT provides primary structural strength for it and a means by which the unit may be installed.

Mounting Holes

The Mounting Holes in the Back Plate provide a means of securing the unit in its' installed location. The holes are designed for use with 1/4" bolts, and it is important to use bolts in both holes when mounting.

LCD Display

The 16-character, 1/2" high, LCD Display is your "information center". It provides such information as software version, mode of operation, units of measure, direction of torque, automatic or manual printing/display clearing status, and warning of low battery power.

Zero Key

The Zero Key is used to return the unit to zero when changing torque test direction, or to zero when drift occurs. It is also used during the calibration process. It is important not to press the Zero key when torque is applied to the transducer.

Clear/Print Key

The Clear/Print key performs two functions. When pressed, it sends the torque measurement on the display to the serial port for communication to a computer or printer, then it clears the display for the next torque measurement.

Auto Key

The Auto key is a toggle switch which activates and deactivates the automatic status of the Clear/Print function. When automatic print/automatic clear function is active, an "A" will appear behind the measurement units on the LCD display. When the automatic print/automatic clear function is deactivated, the displayed measurement must be printed and cleared manually by pressing the Print/Clear key, and no "A" will be displayed.

Units Key

The Units key is used to page through the measurement units the tester offers. The measurement units available on each tester are given in the specifications chapter of this manual. Each time this key is pressed, it pages to the next measurement unit available in the series.

Peak Select Key

The Peak Select key is used to select from among the three modes of operation: Track, Peak, and Initial Peak. When turned on, your Delta Regis tester always boots into Track mode. Each time this key is pressed, it pages to the next mode of operation.
Track mode is used for calibration of the DRTT tester. When the tester is in Track mode, "Tk" will be displayed at the far right of the LCD.
Peak mode is used for testing all non-impacting power tools. This includes clutch, stall, and pulse-type tools. Your Delta Regis DRTT tester cannot be used to test impact

wrenches. When the tester is in this mode, "Pk" will be displayed at the far right side of the LCD.

Initial Peak mode is used for testing clicker-type torque wrenches and torque screwdrivers. This mode captures the torque at which the torque stopped rising due to activation of the torque-limiting mechanism inside. When the tester is in this mode, "IP" will be displayed at the far right of the LCD.

Filter Key

Filters are electronic devices which "clean up" the analog electrical signal coming from the torque transducer before the signal is measured and the measurement converted to torque. This filtering removes some of the top of the wave peak and the bottom of the wave trough in the signal from the transducer. There are five of these filters in the DRTT tester, and they are numbered "0" through "4". The lower the filter number, the more of the peak and valley is discarded before the signal is sent on for processing. The Filter Key pages through the four available filters in sequence. More about filters may be found in Chapter 5.

Transducer

The transducer is the device which uses Hooke's Law and Ohm's Law to convert applied torque into an electrical signal. The front of the transducer has a male hex drive. It is the transducer to which the torque tool is connected for testing.

Battery Compartment Cover

Retains the rechargeable AA nickel cadmium batteries. This cover should only be removed to replace batteries.

Power Switch

The power switch is used to turn on the tester for use or turn it off when testing has been completed.

Fuse

Your DRTT tester has a ½ ampere Buss fuse in the fuse holder.

Serial Port

The serial port is a 9-pin port for serial communications with either a computer or serial printer. Data is sent to the port for transmission when the display is cleared, whether automatically or manually.

Charger Receptacle

The charger receptacle is provided for connection of the charger to the tester.

Chapter 2 - Installing Your Delta Regis Torque Tester

Bench Mounting

The torque tester is designed to be mounted securely to a bench or other suitable support, using two ¼" diameter bolts (SAE grade 5 or better). It is imperative that the tester does not move when being used.
The tester will function properly in either a horizontal or vertical plane. In the majority of applications, horizontal mounting is optimal.
When mounting, allow access to the back of the unit for cable hook-up and battery replacement.

Electrical Connection

Battery and Charger Installation

a) Remove the two Phillips head screws holding the battery cover in place on the back of the Delta Regis torque tester.
b) Gently remove the battery cover and attached battery pack from the unit. Do not move the cover and battery pack any further from the unit than is necessary to install the batteries! The wires from the battery pack to the internal electronics are small and soldered at each end. Placing excessive tension on them will break the wires and necessitate returning the unit for repair!
c) Following the battery orientation shown inside the battery pack, install all four AA NiCd batteries supplied with the unit.
d) Re-install the cover and battery pack.
e) Plug the charger pin into the charger pin receptacle on the back of the unit.
f) Plug the other end of the charger into a properly wired 120 VAC outlet.

Computer Communications (Optional)

If you will be using your Delta Regis tester with a computer and TTM software or a serial printer, this is the time to establish communications.
a) Insert the male end of your 9-pin serial cable into the serial port on the back of the tester.
b) Install the other end of the serial cable to the serial port on your computer or serial printer.
c) Serial communications parameters are: 4800 baud, No parity, 8-bit, 1 stop bit.

Test Installation

The last step in the installation process is checking to insure the unit works as installed.

Move the power switch to the on position. The LCD display will come on, a series of messages will be displayed, and the unit will finish in Track mode at zero torque value in English units of measurement.
If the unit does not turn on, check to ensure that the charger is plugged in properly.
If problems persist, please consult Delta Regis.

Chapter 3 - Testing Torque Wrenches & Manual Torque Screwdrivers

This section covers the testing of clicker-type torque wrenches and manual torque screwdrivers using your Delta Regis DRTT tester. These tool types have a specified accuracy of ± 4% to ± 6% Indicated Value (I.V.) or less, and are suitable for testing on the Delta Regis torque tester, which has an accuracy of ± 1% I.V. Tools of accuracy tighter than ± 4% I.V. should be tested on a torque tester of tighter accuracy. This includes most dial- and beam-type torque wrenches. This section assumes your torque tester has been properly installed, and that any communications connections have been made. If these steps have not been performed, please perform them according to the instructions in the preceding chapter.
A clicker-type torque wrench will be used as an example in this chapter's text. The procedure for testing a torque screwdriver is the same as that used for the torque wrench.

Starting the Delta Regis Torque Tester

Move the power switch to the ON position.

a) Allow the torque tester to boot up. During this process, two messages will be displayed on the LCD indicating the version and model number of the Delta Regis torque tester.
b) After these two messages have been displayed and cleared, the tester will display its operating status on the LCD. This will consist of:
   i) A plus (+) or minus (-) sign in front of
   ii) a torque value at or near zero, followed by
   iii) the units of measure currently in use.
   iv) There will then be one or two blanks, followed by
   v) "TK" to indicate the tester is in Track mode.
c) If the displayed torque value is not zero, press the Zero key to return the tester to zero value.
d) Press the Peak Select key twice to page from Track mode to Initial Peak mode. The last two characters on the display will change to "IP" when the tester has entered this mode.
e) If you wish the test results to automatically print and clear from the LCD within a few seconds of test completion, press the Auto key once. An "A" will be displayed immediately behind the units of measure. If you wish the torque measurement to be displayed until you wish it cleared, you need do nothing. Clearing each measurement from the display will require pressing the Clear/Print key after each display when in manual mode.

Preparing the Torque Wrench

Check that the torque wrench to be tested is of equal or lesser torque capacity than the tester. Under no circumstances should the tester be used beyond its' rated capacity! Adjust the torque wrench to the desired torque level for testing.

Install a socket on the front of the torque wrench, so that the wrench can engage with the male hex drive on the transducer of the DRTT tester.

Testing the torque wrench

Grasp the torque wrench at its' load point, and apply slowly increasing force steadily until it clicks. Stop applying force immediately, and allow the torque wrench to reset. The measurement will be displayed on the LCD.

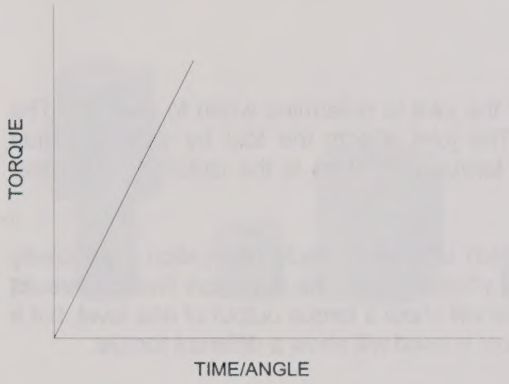
Chapter 4 - Joint Simulators and Power Tool Testing

Joint Hardness and Joint Simulators

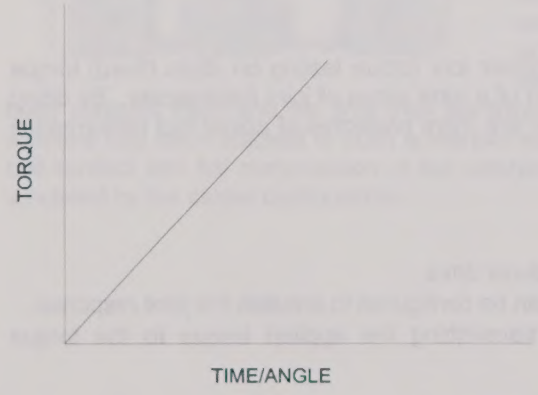
Joint Hardness

Joint hardness is the rate at which a joint develops clamping force as torque is applied to the fastener. Any given joint may be "hard", "soft", or somewhere in between.

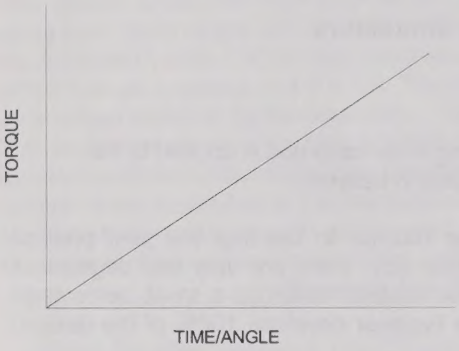
A "hard" joint is one which requires very little fastener rotation to develop the joint preload (clamping force) desired for the assembly. Stated another way, there are very few degrees of fastener rotation, and very little time, from the moment the fastener develops a small percentage (10%) of the fastener preload desired to the moment the fastener develops 100% of the desired preload.



This is depicted in the first diagram. In this diagram, the horizontal axis is time or rotation angle, and the vertical axis is the torque which results in clamping force. The very rapid rise in torque and clamping force over very little time is what defines a hard joint.



The next diagram is of a medium joint. Notice that the rise in torque and clamping force takes more time - fastener rotation - than it did in a hard joint.



The third diagram is of a soft joint. Notice the slow rise in torque; it takes more time - and fastener rotation - to reach the same installation torque.

Joint Hardness and Power Tool Calibration

All non-impacting power tools rely on the reaction of the joint to determine when to shut off. The tool affects the joint by tightening the fastener. The joint affects the tool by varying torque feedback. The feedback is as much a part of the torque control as is the clutch or valve that triggers the tool shutoff.

If a power tool is tested or calibrated on a joint which is feeding back information significantly different from the feedback the power tool will receive when used on the assembly line, the results may be markedly different from each other. The tester will show a torque output of one level, but a test of the fastener torque on the assembly after the tool is used will show a different torque.

It is for this reason that joint simulators were developed, and are used in most power tool calibrations.

Joint Simulators

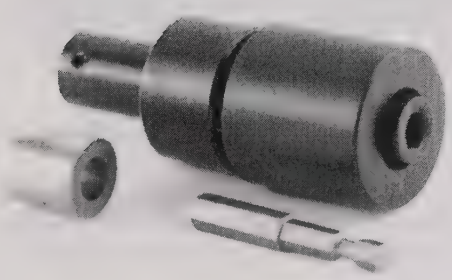
A joint simulator is a device intended for use in power tool torque testing on static (fixed) torque transducers. It is designed to emulate the reaction of a wide range of joint hardnesses. By doing this, it permits the user to obtain test results which are more predictive of actual tool performance on the line.

Joint simulators are devices containing:

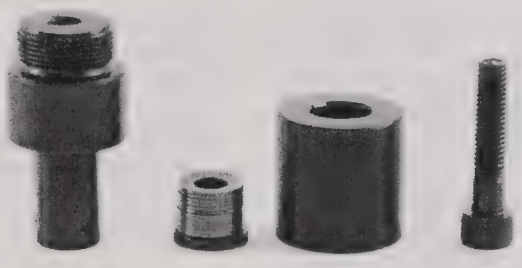
- A means of being attached to the torque transducer drive.
- A set of Belleville washers (or springs) which can be configured to emulate the joint response.
- A means of tightening the washers while transmitting the applied torque to the torque transducer.

The joint simulator may or may not contain additional elements such as multi-part housings.

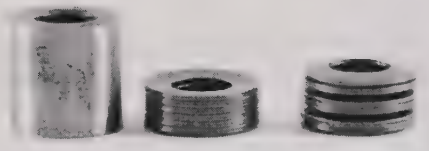
Below are four photographs of two different joint simulators. Each simulator is shown both completely assembled and in a disassembled condition showing the various components which comprise it.



This is a joint simulator and its accessories as received. The large cylinder is the joint simulator itself. The separate hex driver bit to the front is placed in the chuck of the power tool to be tested, and used to engage the bolt in the joint simulator. The small cylinder to the left is the hard joint cylinder used in the joint simulator when emulating a hard joint.



This is the joint simulator disassembled. From left to right, the components are the base, the Belleville washers, the housing, and the bolt. To use the joint simulator, the washers are configured to emulate the joint, then stacked on the bolt. The bolt is then threaded about ¼" into the base. The housing is installed over the bolt and threaded onto the external threads on the base. The joint simulator is then ready for installation on the tester transducer.



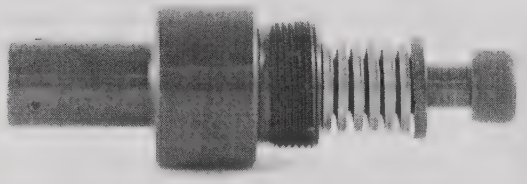
To the left in this photograph is the hard joint cylinder, used in place of the washers when the simulator is to emulate a hard joint. In the center, a stack of washers has been turned to face all the same direction. Stacked this way, the washers emulate a joint very close to a hard joint; there is very little travel or time between when the bolt head contacts them and the time they are fully-compressed. On the right, the same number of washers has been stacked in such a manner as to provide more bolt rotation and time between bolt contact and full compression of the washers. This will emulate a joint softer than the one emulated by the center configuration.

In these two photographs, two more washer configurations are displayed, each as stacked on the bolt. The photograph on the left depicts a stack which will emulate a joint slightly harder than the stack in the photo to the right.

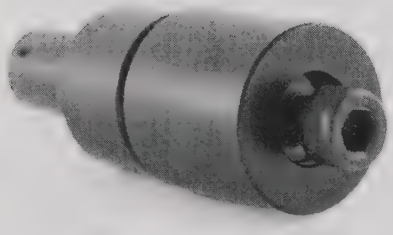
There is a simple rule of thumb which can be used to determine whether one stack of washers will emulate a harder or softer joint than another - the taller the stack of the same number of washers, the softer the joint it emulates.

This is because it takes more bolt rotation and more time to compress the taller stack of washers.

In practice, the same amount of rotation it takes to tighten the actual joint should be emulated on the joint simulator as closely as possible. This is the first and most basic step in matching tool test performance to actual tool performance.

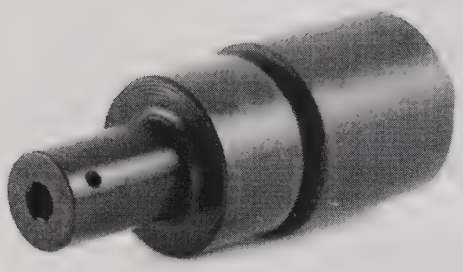


Once the proper washer stackup has been determined and placed on the bolt, the bolt is loosely installed in the simulator base.
Loose installation provides room for tool rundown prior to engaging the washers, just as will occur in actual component assembly on the production line.



The next step is to thread the housing cover onto the simulator base. Thread the housing all the way down, and tighten just finger tight.

Once this is done, the simulator is ready for installation on the tester.

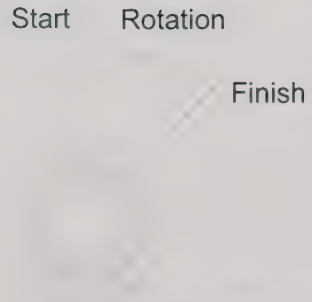


This photograph shows the rear of the joint simulator, with the base to the front. Two #8-32 setscrews are located in the small neck diameter of the base. To install the joint simulator, use a hex key to back the setscrews out of the female hex. The female hex is then engaged to the male hex of the transducer (or adapter, on larger units), and the setscrews tightened just enough to hold the simulator in place on the tester.

Once the joint simulator is configured and in place on the tester, the tester itself may be configured for testing.

Rotation Measurement Procedure

This procedure is that used to measure the amount of rotation used to configure the joint simulator, and is to be conducted on the actual joint the power tool will assemble. A dial- or beam-type torque wrench and a goniometer or other device to measure degrees of rotation will be needed. Even a piece of cardboard and a marker can be used to record the start and finish points for rotation measurement.



a) Install the components of the joint and start the fastener.
b) Run the fastener down to the point at which its' bearing surface contacts the surface against which it will be seated.
c) Use the torque wrench to tighten the fastener to between 1% and 5% of its' final installation torque. This is the start point for measuring rotation. See drawing.
d) If necessary, mark the start point.
e) Use the torque wrench to tighten the fastener to the final installation torque.
f) If necessary, mark the finish point.
g) Measure and record the number of degrees of rotation. This is the amount of rotation the joint simulator should have from the same start and finish torques to emulate the actual production joint.

Joint Simulator Washer Configuration Procedure

This procedure is used to obtain a washer stackup which will emulate the actual joint to be tightened by the power tool. The goal is that the same number of degrees of rotation be obtained on the joint simulator as was measured in the prior procedure for the same torque values. A hex key of the same size as the female hex on the joint simulator, the dial- or beam-type torque wrench, and a goniometer or other means of measuring the angle of rotation of the bolt in the joint simulator will be needed.

1) Evaluate the washers needed to emulate the assembly joint.
   a) If the degrees of rotation from Start to Finish from the prior procedure was $\leq 10°$, use the hard joint cylinder in place of the washers for the balance of the procedure.. Skip the next step.
   b) If the degrees of rotation were $> 10°$, use the washers.
2) Select a washer stackup providing the desired rotation obtained in prior procedure.
3) Install the washers on the bolt.
4) Install the bolt, loosely, in the body of the joint simulator.
5) Install the housing cover on the joint simulator.
6) Attach the joint simulator to the hex key using the method described earlier in this chapter.
7) Use the methodology from the prior procedure to measure the degrees of rotation obtained on the joint simulator.
8) Evaluate the result.
   a) If the degrees of rotation are the same $\pm 10°$, the joint has likely been successfully emulated and can be used with this configuration. The joint simulator can be removed from the hex key and is ready for use on the tester.
   b) If the degrees of rotation are more than $\pm 10°$, the joint has likely not been successfully emulated and cannot be used with this configuration.
      i) If the rotation obtained in this procedure was greater than that sought, the washers stackup will have to be made shorter, emulating a harder joint.
      ii) If the rotation obtained in this procedure was less than that sought, the washer stackup will have to be made taller, emulating a softer joint.
      iii) Remove the joint simulator from the hex key.
      iv) Adjust the washer stackup as indicated.
      v) Repeat steps 4 through 9 of this procedure.

Chapter 5 – Filters

Purpose

The electronic filters in the Delta Regis DRTT Digital Torque Testers perform two key functions: preventing electronic noise from causing inaccurate torque readings, and assisting in the discrimination of the true applied torque signal from the extraneous signals generated by power tool mechanisms.

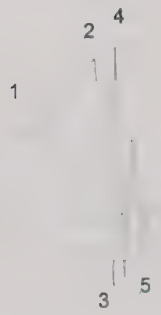
The first of these filtering functions is straightforward. These testers are used in electronically "noisy" environments. Lights, electric motors, and power lines are just some of the sources of electronic noise present in factories and laboratories. The wires in the torque tester can pick up this noise, and send it to the torque analysis circuitry. Part of the purpose of the filters is to eliminate this problem.

The second purpose of the filters is to enable the user to separate the mechanical actions of the power tool which perform the work of applying torque from those actions which result in signals but which do not actually apply torque to the fastener.

Filtering Concept

In Chapter 4, concept drawings were used to explain the relationship of time and degrees of rotation to the applied torque and the clamping force it generates. For the sake of clarity, these drawings were simplified to straight lines. The next drawing is more typical of the actual performance of a power tool in use, as shown on an oscilloscope.

In this drawing, time is the horizontal axis, and voltage is the vertical axis. The horizontal line is the starting voltage from which torque is measured. The horizontal line = no torque. The erratic line is the voltage coming from torque transducer, unfiltered.



In this drawing, the power tool has been used to run down a single fastener. The tool shut off when it reached the shutoff torque.

The slope of the line (#1) during the rundown of the fastener is not a smooth line; the rundown is not as smooth as it appears to the human eye. The acceleration and deceleration of the torque application rate is the result of the inevitable imperfections in the fasteners, the power tool, the joint components, and how they interact during the rundown phase of the power tool use.

The tool actually shut off at the peak labeled point #2. Once the power driving the bit was shut off, regardless of the means, the bit rebounded off the drive of the fastener, and created a backlash through the drive mechanism of the tool. This created torque in the opposite direction, as displayed by the line running from point #2 to point #3. The components of the tool drive continued to rebound off each other, as shown in points #4, #5, and the rest of the line to the right of them, until it stabilized at zero.

The graph discloses a number of peaks during fastener rundown, as well as those occurring at and after tool shutoff. This type of action – not identical, but similar – occurs with all non-impacting power tool types on all joints. There are many variables involved: the power tool type, the individual tool, the fasteners, the joint rate, the tool power supply, rundown speed, the tool's shutoff mechanism, and the broad variety of the interactions between them. These sources of mechanical "noise" create the electronic noise that must be eliminated to determine what will be the actual applied torque on the fastener.

It is the filter, augmenting the joint rate emulation of the joint simulator, which permits effective off-line calibration with confidence the results on the tester will correlate with the results in the assembly process.

There are five (5) filters provided on each Delta Regis DRTT tester. The filters are numbered 0, 1, 2, 3, and 4. Each filter provides a different amount of noise reduction, with Filter 0 having the most filtering and Filter 4 the least.

Since there are only five filters, and there is an almost infinite variety of joints and power tools on which the tester might be used (and more power tools and applications coming out every year), learning to balance the joint simulator and the filters is a key to assuring a successful power tool testing program.

Chapter 6 – Testing Power Tools

This chapter covers testing power tools on the Delta Regis tester. Power tools require the use of a joint simulator as well as the filters on the DRTT tester. This procedure assumes the tester has been mounted in its' proper location and appropriate power supplied to the unit, per instructions earlier in this manual.

Procedure

1) Measure Joint
   a) Use the following procedure to obtain information on the actual torque output of the power tool.
      i) Use the tool to be tested to tighten the actual joint the tool will be used on. Insure that the tool is used just as it would be under normal operating conditions.
      ii) Mark the fastener (or socket driving the fastener) and the mating surface of the component being fastened with a reference line.
      iii) Attach a direct reading (eg. dial type) torque wrench to the socket or bit
      iv) Slowly and carefully apply steadily increasing force to the torque wrench until the fastener starts to move. It is important the torque applied be just enough to barely move the fastener. If the fastener is rotated more than just a few degrees, the torque measurement will be higher than the applied torque by a significant percentage This is the point at which torque application stops and the torque reading is taken.
      v) Record the obtained torque. This number will be the one used in selecting the correct filter. You may wish to repeat the above steps several times to assure you do not have a "flier" as your data point.
   b) Determine the joint hardness.
      i) On a new assembly, use a dial- or beam-type torque wrench to tighten the fastener the power tool will be used on to 10% of its' specified installation torque.
      ii) Use a goniometer, protractor, or other means of accurately measuring degrees of rotation, to measure the rotation required to move the fastener from 10% of the installation torque to 100% of the installation torque. Use the torque wrench to perform the tightening.
2) Use the instructions in Chapter 4 to configure the joint simulator to approximate the amount of rotation required to tighten the fastener from 10% of the installation torque to 100% of the installation torque.
3) Use the instructions in Chapter 4 to install the joint simulator on the DRTT tester.
4) Start the Delta Regis tester.
   a) Use the Power Switch to turn on the tester, and allow it to boot up.
   b) Use the Units key to select the units of measure to be used.
5) Use the Mode key to select the Peak mode (PK). The tester will automatically select Filter 0.
6) Press the Zero key to assure the tester is zeroed prior to the test.
7) Test the tool.
   a) Use the power tool to tighten the socket head cap screw of the joint simulator.
   b) Record the torque displayed on the LCD of the tester.
   c) Loosen the socket head cap screw back to its' original position.
   d) Press the Clear/Print key to clear the display.
   e) Repeat the above four steps two more times.

8) Compare the results to the actual applied torque obtained from the joint.
   a) If the results are well correlated to the actual output of the tool on the joint, record the information on the joint simulator washer configuration and filter used for the test for future use. Testing complete.
   b) If the results are not well correlated to the actual output of the tool on the joint, and all filters have not yet been tried, another filter may be better to use with this combination of tool and joint. Go to step 9.
   c) If the results are not well correlated to the actual output of the tool on the joint, and all filters have been tried, then an adjustment to the joint simulator will be needed.
      i) Use the Power Switch to turn off the tester.
      ii) Remove the joint simulator from the tester.
      iii) Use the instructions found in Chapter 4 to make the joint simulator emulate a slightly harder or softer joint.
      iv) Return to Step 3 of this procedure.
9) If correlation is not obtained and all four filters have not yet been tried, it may be that the joint simulator is correct but a different filter may be needed.
   a) Press the Filter button on the DRTT tester to change to the next filter.
   b) Repeat steps 6, 7, and 8 of this procedure.

Specifications

Characteristic	Specification
Accuracy	+/- 0.5% Indicated Value from 20%-100% of range +/- 1% Indicated Value from 10%-20% of range +/- 2% Indicated Value from 5%-10% of range
Accuracy Direction	Bi-Directional, Clockwise and Counter-Clockwise
Modes	Track, Peak, Initial Peak
Display	½" High, 16 Character LCD
Controls	Six button keypad: Zero, Clear/Print, Auto, Units, Peak Select, Filter
Filter	Five user-selectable cut-off frequencies in Peak Mode
Communication	RS-232C Serial Port, 9 pin. Baud Rate - 4800, Stop Bits - 1, Parity - None
Voltage	120 VAC
Charger	Trickle Charger
Batteries	Four NiCd, 1100mA (max.) 1.5VDC
Battery Life	Five hours
Full Charge Time	Twenty hours with supplied Trickle Charger
Weight (lbs)	10.5
Dimensions (inches)	10.5W x 6D x 3.5H

Torque Meter Models

Model	Torque Range	Drive Size
DRTT10	0.5-10 in.lbs. / 0.06-1.13 Nm	1/4" male hex
DRTT35	1.75-35 in.lbs. / 0.2-4 Nm	1/4" male hex
DRTT100	5-100 in.lbs. / 0.6-11.3 Nm	3/8" male hex
DRTT300	15-300 in.lbs. / 1.7-33.9 Nm	3/8" male hex

Joint Simulator Models

Model	Capacity	Used With	Drive Size
DRTT-JS10	10 in. lbs	DRTT-10	1/4" F. Hex
DRTT-JS35	35 in. lbs	DRTT-35	1/4" F. Hex
DRTT-JS35-38	35 in. lbs	DRTT-100	3/8" F. Hex
DRTT-JS300	300 in. lbs	DRTT-100; DRTT-300	3/8" F. Hex